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AUTHOR Parker, Steve
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ABSTRACT

Classical phonemic accounts of Cuzco (Peru) Quechua posit three distinct types of stops: plain, aspirated, and glottalized. A later analysis argued instead for a root-level feature of laryngealization governed by a small number of formal mechanisms. This latter analysis is taken one step further, showing that even greater explanatory power may be achieved by appealing to Optimality Theory. It begins with an overview of Quechua phonology and the distribution of laryngealized stops. It is found that laryngealization in this language is not a characteristic of individual phonemes, but of entire roots, with distribution accounted for relatively easily. Constraints discussed include the features [constricted glottis] and [spread glottis], an alignment constraint, a constraint inhibiting the shifting of laryngealization, the coda filter, root faithfulness, the obligatory onset condition for all syllables, and an effect of the obligatory contour principle. (Contains 13 references.) (MSE)

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Steve Parker

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An OT Account of Laryngealization in Cuzco Quechua*

Steve Parker

Classical phonemic accounts of Cuzco Quechua posit three distinct series of stops: plain, aspirated, and glottalized. Parker and Weber 1996 argue instead for a root-level feature of laryngealization governed by a small number of formal mechanisms. In this paper, the analysis is taken one step farther and it is shown that even greater explanatory power may be achieved by appealing to the model of Optimality Theory.

1. Introduction

The purpose of this paper is to present an account of glottalized and aspirated stops in Cuzco Quechua, spoken in Peru, within the framework of Optimality Theory (Prince and Smolensky 1993). The groundwork for this study was laid by Parker and Weber (1996), who basically described the facts and proposed an analysis of them in terms of autosegmental theory and Grounded Phonology (Archangeli and Pulleyblank 1994). I will first review the distribution of glottalized and aspirated segments (which I will henceforth group together under the common label 'laryngealized', as in Parker and Weber 1996). Having done so, I will then show how the same facts can be accounted for in terms of violable constraint ranking and interaction, the central premise of Optimality Theory.

2. Overview of Quechua phonology

Cuzco Quechua exhibits the standard five vowel inventory, /i e a o u/. Primary stress normally falls on the penultimate syllable of each word. If we ignore some minor complications, virtually all Quechua words can be exhaustively parsed with the maximal syllable template [CVC]. Consequently, word-medial consonant clusters are always heterosyllabic: /pis.qa/ *five*. At the underlying level, vowel-initial syllables occur only word-initially, whereas all word-internal syllables must contain an onset. However, at the phonetic level *all* syllables must obey this Obligatory Onset Condition (Itô 1986). Quechua satisfies this constraint by epenthesizing a default word-initial [ʔ], just as many other languages do.

3. Distribution of laryngealized stops

In Cuzco Quechua, the voiceless stops (and affricate) /p t č k q/ may all be contrastively glottalized or aspirated. (/q/ is post-velar or uvúlar.) Thus, it is possible to find minimal pairs and triplets such as the following:

(1) [tanta] *collection, combination*
[tʔanta] *bread*
[tʰanta] *old, used up, worn out*

Because of contrastive examples such as these, classical phonemic accounts in the structuralist tradition posited the following twenty-six individual consonant phonemes for this language, including three distinct series of stops (Rowe 1950, Cusihuamán 1976:291):

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(2)

$p^{?}$	$t^{?}$	$č^{?}$	$k^{?}$	$q^{?}$	
p^{h}	t^{h}	$č^{h}$	k^{h}	q^{h}	
p	t	č	k	q	
	s	š			h
m	n	ñ			
	l	ʎ			
	r				
w		y			

However, as Parker and Weber (1996) note, many previous authors have observed that the laryngealized stops are subject to extreme phonotactic restrictions. Thus, while the plain consonants listed in (2) may occur in onsets or codas, in roots or in suffixes, and more than once in the same root, laryngeal stops are limited by the following constraints:

(a) They occur only in roots, never in suffixes.

(b) They occur only in the onset position of the syllable, never in codas.

(c) When laryngealized consonants do occur, they are always the first syllable-initial stop of the root (or word, since there are no prefixes). Thus, forms such as the hypothetical *[poq$^{?}$a], in which the second stop is glottalized (rather than the first one), are systematically non-attested.

(d) They may occur only once per root. No Quechua root contains two aspirated stops or two glottalized stops. Furthermore, glottalization and aspiration are mutually exclusive in the sense that they never co-occur in the same root. Thus a word may have an aspirated stop or a glottalized one, but not both. The generalization is that laryngealization is restricted to one occurrence per root.

(e) Aspirated consonants and /h/ are mutually exclusive with respect to roots. That is, if a root contains an aspirated stop, it may not contain an /h/, and vice versa.

(f) Words containing glottalized stops always begin with a consonant. Whenever an ejective occurs in a reflex of a Proto-Quechua root that began with a vowel, in Cuzco Quechua the word begins instead with [h]. For example, the Proto-Quechua form for *How many?* is *ayka, while in Cuzco it is [hayk$^{?}$a].

Concerning these last two points, (e) and (f), I wish to clarify that /h/ is indeed a contrastive phoneme in Cuzco Quechua, despite its epenthetic nature in forms such as [hayk$^{?}$a]. Thus, not all words that begin with an [h] contain a glottalized stop later in the root; for example, /hatun/ *big, tall.*

The following data illustrate the distributional patterns of laryngealized stops described in this section:

(3)

$p^{?}$atay	*to bite*
p^{h}atay	*to explode, blow up*
$t^{?}$anta	*bread*
t^{h}anta	*old, used up, worn out*
$č^{?}$ačU	*treacherous, tricky*
$č^{h}$ačU	*ragged, tattered*
$k^{?}$anka	*rooster*
k^{h}anka	*slimy, clammy*
$q^{?}$ata	*turbid, muddy*

q^{h}ata	*mountainside*
hap^{ʔ}iy	*to light (a fire), grab, hold*
wirp^{ʔ}a	*lip*
sup^{h}u	*body hair*
musp^{h}apakuy	*to be delirious*
ʎat^{ʔ}ay	*to unplug, uncork*
hunt^{ʔ}a	*full, complete*
rakt^{ʔ}a	*thick*
it^{h}a	*species of small insect*
mič^{ʔ}u	*mixed, jumbled*
moqč^{ʔ}ikuy	*to wash or rinse out the mouth*
sunč^{ʔ}u	*yellow aster*
ač^{h}uy	*to postpone, delay*
anč^{h}ayna	*thus, so*
hak^{ʔ}u	*floury*
rank^{ʔ}ukuy	*to get twisted up*
ak^{h}akaw	*How hot it is!*
musk^{h}iy	*to smell*
naq^{ʔ}o	*dented, bruised*
hanq^{ʔ}as	*species of lupine plant*
leq^{h}e	*rotten, putrid*
ranq^{h}a	*forgetful*
warak^{ʔ}a	*sling made of wool*
hamawt^{ʔ}a	*learned, wise*

The obvious conclusion to draw from these facts is that laryngealization in Cuzco Quechua is not a characteristic of individual phonemes, but rather of entire roots. Thus, Parker and Weber (1996) account for these facts in a principles and parameters model by positing the features [constricted glottis] (CG) and [spread glottis] (SG) as floating root-level autosegments which dock by rule to the leftmost syllable-initial stop in the word. This allows us to drastically simplify the phonemic inventory in (2) by eliminating the two series of laryngealized obstruents. Furthermore, as Parker and Weber (1996) point out, the distributional quirks of laryngealized roots with respect to the phoneme /h/ can also be explained as an effect governed by the Obligatory Contour Principle (OCP), as we shall see in the following sections.

4. OT analysis

In this section I will recast the Parker and Weber (1996) analysis in terms of Optimality Theory. Much of the basic groundwork has been laid already by McCarthy (1996). I will draw from his account here and then modify and expand it in order to handle all of the interactions of laryngeal features in Cuzco Quechua.

4.1. Licensing [constricted glottis] and [spread glottis]

In the first place, we must obviously account for the fact that the features [constricted glottis] and [spread glottis] surface only on stops and in isolation. This can be accomplished by stipulating the structural conditions for these features as follows:

(4) LicenseCG (LICCG)
The feature [cg] is licensed only in isolation or in conjunction with the following configuration:

[–sonorant]
|
[–continuant]

(5) LicenseSG (LICSG)
The feature [sg] is licensed only in isolation or in conjunction with the following configuration:

[–sonorant]
|
[–continuant]

The addition of "in isolation" to the licensing constraints for [sg] and [cg] is needed in order to allow a phonemic /h/ to surface, and not just aspirated stops. Likewise, the default epenthetic onset [ʔ] needs to be permitted to surface independently of ejectives. As McCarthy 1996 shows, these two constraints must dominate the corresponding MAX constraints in order to filter out hypothetical underlying forms containing laryngealized sonorants (cf. the "richness of the base" principle of OT):

(6)

UR: /mʔaru/	LICCG	MAXCG
a. ☞ [maru]		*
b. [mʔaru]	*!	

The tableau above establishes the ranking of LICCG over MAXCG. Thus the hypothetical underlying glottalization on a sonorant will never surface since high-ranking LICCG compels deletion of this feature in violation of the lower-ranked faithfulness constraint. Comparable arguments could be given for the interaction of aspiration features (LICSG ⟩⟩ MAXSG) as well. For the sake of brevity I will not duplicate all of these details in the ensuing discussion, but will instead use ejectives as examples of how we could deal with aspirates in an analogous way. Therefore, constraints which refer to the feature [constricted glottis] should also be understood as referring to the feature [spread glottis].

4.2. Alignment constraint

In order to account for the fact that laryngealization is always attracted to the leftmost stop in a word, McCarthy 1996 posits an alignment constraint which we can express as follows:

(7) ALIGNCG
Align the feature [cg] with the left edge of a prosodic word.
Align(CG,L,PrWd,L).

The interaction of this markedness constraint with the others already discussed is illustrated in the following tableau as applied to the word /ñukʔu/ *withered*:

(8)

UR: /ñuk$^{?}$u/	LICCG	MAXCG	ALIGNCG
a. ☞ ñuk$^{?}$u			**
b. ñ$^{?}$uku	*!		
c. ñuku		*!	

Candidate (b) [ñ$^{?}$uku] attempts to satisfy ALIGNCG by shifting the glottalization to the word-initial /ñ/. However, this incurs a fatal violation of LICCG, as we have already seen. Candidate (c), however, resorts to a different strategy in order to resolve the misalignment: it deletes the laryngealization altogether. This violates MAXCG, so [ñuku] is also a non-optimal output for this underlying form. The fact that the completely faithful candidate (a) [ñuk$^{?}$u] is the one which correctly surfaces is an indication that ALIGNCG is ranked below MAXCG, as I have shown in this tableau. Thus, perfect alignment can be sacrificed in order not to violate higher ranked constraints, specifically LICCG and MAXCG. As McCarthy points out, while the ALIGNCG constraint dictates that glottalization will show up as far left in the word as possible (all other things being equal), this does not mean that laryngealization will necessarily fall on the word-initial segment in all cases. On the contrary, as we have seen, if the leftmost potential anchor is not a stop or affricate, high ranking LICCG will block glottalization from surfacing on that segment.

It is crucial in this case to count violations of ALIGNCG in a gradient rather than a categorical fashion, since otherwise we could not select between candidates in which glottalization surfaces on the second rather than the third syllable of the root. For example, given a hypothetical underlying form such as /rankuk$^{?}$uy/ (cf. [rank$^{?}$ukuy] *to get twisted up*), Cuzco Quechua requires that the leftmost stop be the one which surfaces laryngealized. This is accomplished in the following tableau since candidate (a) [rank$^{?}$ukuy] receives three marks under ALIGNCG for the segments /ran/ which separate the ejective from the beginning of the word. However, totally faithful candidate (b), [rankuk$^{?}$uy], violates alignment five times and thus fails to survive:

(9)

UR: /rankuk$^{?}$uy/	LICCG	MAXCG	ALIGNCG
a. ☞ rank$^{?}$ukuy			***
b. rankuk$^{?}$uy			****!*

4.3. A constraint inhibiting the shifting of laryngealization

Another constraint which McCarthy also considers is STAYCG. This constraint inhibits the shifting of laryngealization from its underlying locus to some other segment in the word. As the following tableau demonstrates, STAYCG must be ranked below ALIGNCG, since the latter needs to compel a violation of the former in the case of hypothetical underlying forms such as /pat$^{?}$ay/ (cf. [p$^{?}$atay] *to bite*):

(10)

UR: /pat$^{?}$ay/	ALIGNCG	STAYCG
a. ☞ p$^{?}$atay		*
b. pat$^{?}$ay	*!*	

Here the correct surface form [p$^{?}$atay] violates STAYCG in order to perfectly satisfy ALIGNCG, and so is the most harmonic candidate. The loser [pat$^{?}$ay] maintains the glottalization on its underlying anchor, but in doing so fatally violates alignment. (In this case the higher ranking

constraints LICCG and MAXCG are perfectly satisfied by both candidates and so are irrelevant in choosing between the two.)

4.4. Coda filter

As I indicated in §3, another crucial restriction on the distribution of laryngealized stops in Cuzco Quechua is that they systematically never occur in syllable-final position. I would explain this typical example of coda neutralization by pointing out that aspirates and ejectives both involve a high intensity, fortis airstream in their articulation, whereas syllable-final position corresponds to a tapering out of the airstream after the nuclear pulse. We can thus incorporate this insight into our formal analysis by borrowing a constraint posited independently by Lombardi (1995):

(11) AlignLaryngeal (ALIGNLAR)
Align a Laryngeal Node with the left edge of a syllable.
Align(Laryngeal, L, σ, L).

This constraint requires any segment bearing a Laryngeal Node to occur in syllable-initial position. This formalization is crucially based on the assumption that all segments besides ejectives, aspirates, and /h/ are underspecified for laryngeal features, including [±voice], since these are otherwise not contrastive in the language (obstruents are uniformly voiceless while sonorants are voiced). Since phonemic /h/ does not occur syllable-finally in Cuzco Quechua either, the ALIGNLAR filter (11) captures the relevant generalization. This constraint is undominated in this language since no other pressure, even MaxCG, can compel it to be violated. Thus, consider a hypothetical underlying form such as /rak$^{?}$ta/ (cf. [rakt$^{?}$a] *thick*):

(12)

UR: /rak$^{?}$ta/	ALIGNLAR	LICCG	MAXCG	ALIGNCG	STAYCG
a. ☞ rakt$^{?}$a				***	*
b. rak$^{?}$ta	*!			** .	
c. r$^{?}$akta		*!			*
d. rakta			*!		*

As demonstrated by tableau (12) above, regardless of where laryngealization is located in a root underlyingly, the postulated constraint ranking will ensure that it correctly surface on the leftmost *syllable-initial* stop, as we desire. Thus, the winning candidate [rakt$^{?}$a] violates only low ranking ALIGNCG and STAYCG, whereas the perfectly faithful candidate (b), [rak$^{?}$ta], fatally violates the undominated ALIGNLAR filter. Candidates (c) and (d) avoid misalignment but in doing so they fall victims to other higher ranked constraints.

4.5. Root faithfulness

The final detail which McCarthy discusses is the fact that laryngealization in Cuzco Quechua is restricted to roots and thus never occurs in suffixes. (Quechua languages have no prefixes.) He accounts for this common dichotomy by positing a markedness constraint, *CG, which prohibits glottalized segments. This constraint dominates MAXCG, but at the same time is dominated by MAXROOTCG (preserve a CG specification if it occurs in a root). The following tableau illustrates this analysis for the words [t$^{?}$anta] *bread* and [tanta-kuna] *collections*:

(13)

UR: /t$^{?}$anta/	MAXROOTCG	*CG	MAXCG
a. ☞ t$^{?}$anta		*	
b. tanta	*!		*
UR: /tanta-k$^{?}$una/			
a. ☞ tanta-kuna			*
b. tanta-k$^{?}$una		*!	

In the word [t$^{?}$anta] above, the totally faithful candidate (a) wins since its root-initial ejective is maintained. This violates *CG, but the alternative is to delete this feature and thus fatally lose on the higher ranked MAXROOTCG, (candidate (b)). The opposite situation obtains with a hypothetical underlying form such as /tanta-k$^{?}$una/, where [-kuna] is a pluralizing suffix. Here the glottalization on the /k$^{?}$/ is no longer "protected" by MAXROOTCG since it is in an affix. Consequently, *CG kills the totally faithful candidate (b), whereas the winning [tanta-kuna] only violates low ranked MAXCG. In order to be technically correct, I could have included MAXROOTCG and *CG in my earlier tableaux. However, since the same outcomes would result regardless of this fact, I will continue to leave them out for the sake of simplicity.

4.6. Obligatory onset

I now consider the fact that all syllables in Cuzco Quechua obey the Obligatory Onset Condition. Recall that forms which begin with a vowel underlyingly receive a default word-initial [ʔ] in order to satisfy this requirement. In situations like this the [ʔ] is normally considered only a transitional phonetic reflex which plays no active role in the phonology of the language. As we shall observe shortly, however, there is evidence that these [ʔ]'s in Cuzco Quechua are crucially sensitive to certain important constraints.

The presence of epenthetic [ʔ] can be enforced by assuming that ONSET is high ranked, such that it compels violation of DEP (Dependency). ONSET here is the well-known prohibition against vowel-initial syllables, and DEP inhibits the presence of features and/or segments in the output which were not present in the input (i.e., it inhibits epenthesis). The specification of [ʔ] as the default consonant can be achieved by the familiar strategy of ranking *PHARYNGEAL below the prohibition against all other place nodes:[1]

(14) *Labial,*Dorsal ⟩⟩ *Coronal ⟩⟩ *Pharyngeal

The ranking of *LABIAL and *DORSAL above *CORONAL is posited, based on universal patterns of markedness without any specific empirical evidence in Cuzco Quechua. In the markedness hierarchy (14) above, the default epenthetic consonant of choice will be a pharyngeal. However, this leaves open the question of how to enforce the selection of [ʔ] over [h]. Perhaps the simplest solution would be to split *PHARYNGEAL into two more specific constraints, *SG and *CG. However, as Diamandis Gafos (p.c.) has pointed out to me, this ranking is highly stipulatory and does not follow from any independently motivated facts. A better solution would be to rely on Clements' (1990) proposal for a Sonority Dispersion Principle (SDP). Basically this constraint requires that we maximize the sonority slope from onset to nucleus and minimize it from nucleus to coda. Since [ʔ] (a stop) is lower in sonority than [h] (a fricative), the Sonority Dispersion Principle

[1] Here I am using the cover term 'pharyngeal' to include glottal consonants as well, in keeping with a growing body of recent literature. For example, see Prince and Smolensky 1993 and Kenstowicz 1994 (pp. 456-457, citing McCarthy 1991).

will choose [ʔ] over [h] as a preferred onset when all other factors lead to a tie. Below I illustrate the interaction of these constraints for the word [ʔasikuy] *to laugh*:

(15)

UR: /asikuy/	ONSET	DEP	*LAB,*DOR	*COR	*PHAR	SDP
a. ☞ ʔasikuy		*	**	*	*	
b. asikuy	*!		**	*		
c. tasikuy		*	**	**!		
d. hasikuy		*	**	*	*	*!

In the tableau above, the winning candidate [ʔasikuy] violates DEP due to the insertion of a word-initial [ʔ]. This is tolerated, however, since it satisfies top-ranked ONSET, whereas totally faithful [asikuy] fails in this respect. All of the candidates share in common two violations of *DOR (one for the /k/ and one for the /y/) and one of *COR (for the /s/). In addition, [tasikuy] entails a second and fatal violation of *COR whereas [hasikuy] and [ʔasikuy] equally violate the low-ranked *PHAR. However, since [ʔasikuy] begins with a (voiceless) stop, its initial onset-nucleus sonority slope is perfectly maximized, whereas the initial fricative in [hasikuy] fatally violates the Sonority Dispersion Principle. Thus, [ʔasikuy] emerges as the correct winning candidate.

4.7. An OCP effect

We now come to the interesting stipulation that no root in Cuzco Quechua may contain two ejectives, two aspirates, or an aspirated stop plus an /h/. As Parker and Weber (1996) argue, these examples of root co-occurrence limitations are prototypical OCP effects. Thus, we can account for these phenomena by positing that in this language the OCP constraint dominates MAXCG and MAXSG (or, more precisely, MAXROOTCG and MAXROOTSG) because it requires unfaithful deletion in those cases in which Gen supplies an input containing two identical laryngeal specifications. Consider as an example the hypothetical underlying representation /qʔatʔa/ (cf. [qʔata] *muddy*):

(16)

UR: /qʔatʔa/	OCP	MAXCG	ALIGNCG
a. ☞ qʔata		*	
b. qʔatʔa	*!		**
c. qatʔa		*	*!*
d. qata		**!	

The winning candidate [qʔata] obeys the OCP by deleting the glottalization on the second stop and thus only violates MAXCG. Candidate (b), on the other hand, faithfully preserves both underlying ejectives but in doing so fatally violates top-ranked OCP. Candidate (c) is similar to (a) in that it maintains only one occurrence of [cg]; but (c) violates ALIGNCG since it preserves glottalization on a non-initial stop. Finally, candidate (d) is not optimal because its double deletion of the underlying glottalization violates MAXCG twice.

In the following tableau I give a further example illustrating the interaction of these constraints with the feature [sg] for the hypothetical underlying form /huqʰari/ (cf. [huqari] *to lift*):

(17)

UR: /huq^{h}ari/	OCP	MAXSG	ALIGNSG
a. ☞ huqari		*	
b. huq^{h}ari	*!		**
c. uq^{h}ari		*	*!
d. uqari		**!	

In this case candidate (a) is correctly predicted to win, for the same reasons as with tableau (16). However, what is interesting is that the cognate form of this word in Bolivian Quechua, a closely related dialect, is [uq^{h}ari], candidate (c). In this latter form the potential OCP violation is avoided by leaving off the word-initial [h] rather than by de-aspirating the /q^{h}/. In order to derive this outcome some additional constraint would be needed. I do not know if Bolivia Quechua even has the phoneme /h/, or perhaps it does not license it word-initially. Perhaps a solution along these lines would work; I will not pursue the matter here.

I am now in a position to account for the fact that the default epenthetic onset in glottalized roots surfaces as [h] rather than [ʔ]. This can be seen as another case of OCP blockage on the [cg] tier (Parker and Weber 1996). Assuming that the OCP and ONSET constraints are undominated in Cuzco Quechua, observe the evaluation of the following set of candidates for /ayk^{ʔ}a/ → [hayk^{ʔ}a] *How many?*:

(18)

UR: /ayk^{ʔ}a/	ONSET	OCP	DEP	MAXROOTCG	*PHAR	*SDP
a. ☞ hayk^{ʔ}a			*		*	*
b. ayk^{ʔ}a	*!					
c. ʔayk^{ʔ}a		*!	*		*	
d. hayka			*	*!	*	*
e. ʔayka			*	*!	*	

In tableau (18), the high ranking ONSET constraint compels initial epenthesis. Since the totally faithful candidate (b), [ayk^{ʔ}a], does not fulfill this requirement, it is immediately knocked out of the running. Candidate (c), [ʔayk^{ʔ}a], has the normally expected default onset [ʔ], but since an ejective occurs later in the root, the introduction of this segment violates the OCP. Candidate (a), [hayk^{ʔ}a], however, avoids this problem by epenthesizing an [h] rather than a [ʔ]. Since this violates only the lower ranked *PHAR and SDP constraints, [hayk^{ʔ}a] is correctly selected as the most harmonic output. Candidates (d) and (e) attempt to sidestep the potential OCP violation by deleting the [cg] feature on the underlying ejective. This violates the faithfulness constraint MAXROOTCG, sealing their fate as non-optimal forms. As Parker and Weber (1996) note, the insertion of a word-initial [h] in glottalized roots can thus be seen as a dissimilation process triggered by the OCP. Epenthetic [ʔ] and [h] are in complementary distribution in this language; the undominated requirement for an onset leads to a default [ʔ] in most cases since *PHAR is at the bottom of the markedness hierarchy for consonants. However, when the high ranking OCP would be violated (and only then), [h] appears instead. One aspect of this analysis which is theoretically significant is that word-initial [ʔ]'s are normally considered to be nothing but a transitional phonetic reflex, especially when there is no corresponding /ʔ/ phoneme in the language. In Cuzco Quechua, however, this postlexical segment crucially interacts with independently-needed phonological constraints such as the OCP in a unique and interesting way.

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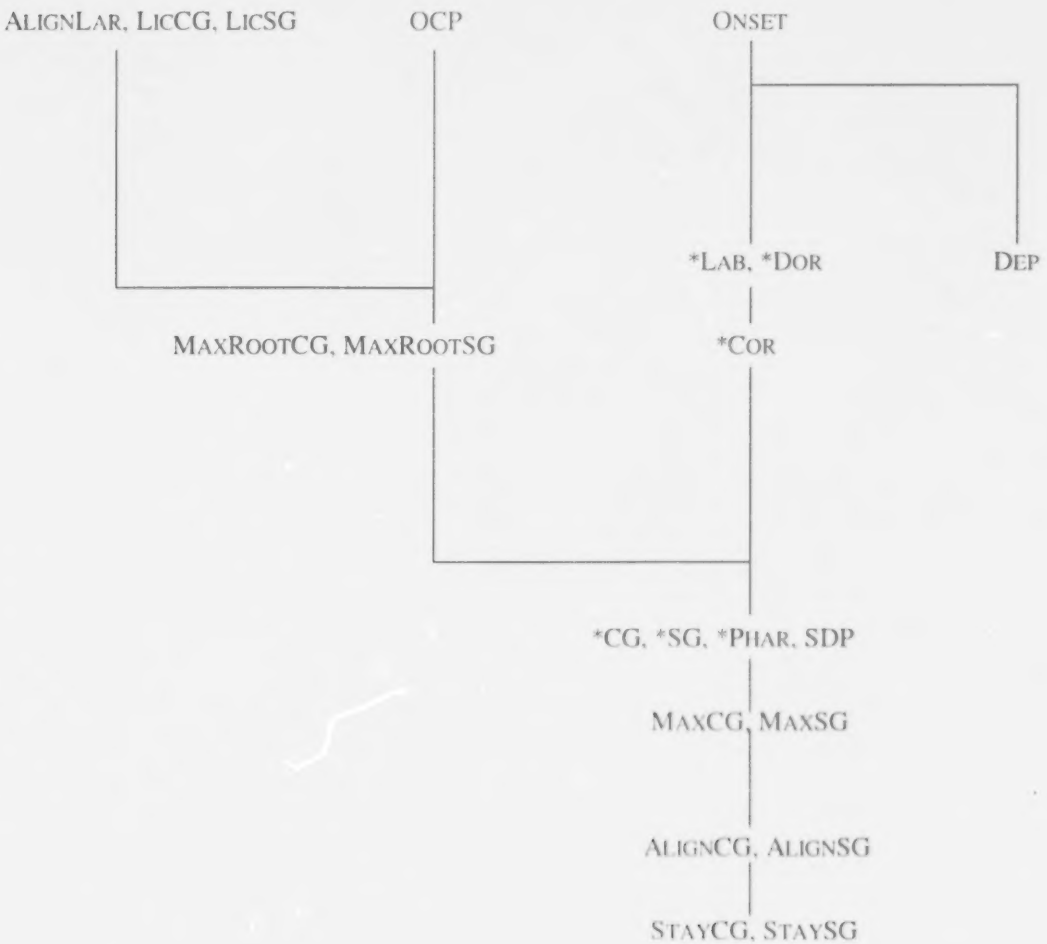
5. Conclusion

In this sketch I have outlined an account of laryngealization in Cuzco Quechua in terms of Optimality Theory. Perhaps the most interesting detail of the analysis is a Panini or Elsewhere type of interaction between [ʔ] epenthesis and [h] epenthesis. These latter processes provide additional confirmation of the fact that Pharyngeal, not Coronal, is the universally unmarked place node for default consonants.

Appendix: Ranking of constraints



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Steve Parker
Department of Linguistics
226 South College
University of Massachusetts
Amherst, MA 01003
U.S.A.

sgparker@linguist.umass.edu